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Agricultural Memorandum No.549

Estimation of County Values of Excess Winter Rain

L P Smith and J Cochrane

Average values of data concerning excess winter rain for about 80 individual stations are available in MAFF Technical Bulletin No.24[1]; in addition, water balance calculations for a different selection of stations are carried out during the summer months on a regular basis and these can readily be extended to give return dates and excess winter rainfall values.

County annual rainfall averages are available[2] and from these, and from individual station averages, regression estimates of average excess winter rainfall, for stations and counties, can be made after the method of MAFF Technical Bulletin No.24.

The ratio of station to county averages of excess winter rain gives a conversion factor which allows an estimate of the county value of excess winter rain to be made from an individual station value in a given season, and the use of the weighted average of one or more stations within a county with selected stations in surrounding counties should provide a more reliable estimate of the county value than has been available by using simple point values. Weighting factors were 2 for stations within the county and 1 for stations from surrounding counties. In a few cases where no representative station was available within the county, a suitable station in a neighbouring county has been used with the "within county" weighting.

Values of estimated excess winter rain for counties and stations with their conversion factors are shown in the appendix and these can be applied in a particular season as in the following example:-

Northumberland 1972-73

Station	Excess Winter Rain	Conversion Factor to County Value	Weighting Factor
Berwick	0.0 ins	2.18	2
Acklington	0.5 "	1.79	2
Carlisle	5.2 "	1.11	1
Tynemouth	0.0 "	1.94	1
Newton Rigg	10.9 "	0.96	1

(Note: Conversion factor is obtained from appropriate average values.)

Excess Winter Rain for Northumberland 1972-73

$$= 1/7 \left[2(2.18 \times 0.0) + 2(1.79 \times 0.5) + (1.11 \times 5.2) + (1.94 \times 0.0) + (0.96 \times 10.9) \right]$$

$$= 2\tfrac{1}{2} \text{ inches}$$

Any comments or suggestions to this paper should be referred to the author.

Meteorological Office
Bracknell

May 1973

References

1. MAFF. The Significance of Winter Rainfall over farmland in England and Wales, Tech. Bull. No.24, HMSO, 1971.

2. Meads, D and Smith, L. P., County rainfall averages (1916-1950), Agr. Memo. No.61, 1963.

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APPENDIX

	County	County Average EWR ins	Reference Stations In County	Station Average EWR ins	Conversion Factor	Reference Stations Outside County	Station Average EWR ins	Conversion Factor
1.	Northumberland	15.9	Berwick	7.3	2.18	Carlisle	14.4	1.11
			Acklington	8.9	1.79	Tynemouth	8.2	1.94
						Newton Rigg	16.6	0.96
2.	Cumberland	31.4	Carlisle	14.4	2.18	Newton Rigg	16.6	1.89
			Sellafield	25.8	1.22	Cartmel	29.1	1.08
3.	Durham	14.2	Tynemouth	8.2	1.73	Acklington	8.9	1.60
			Durham	8.6	1.65	Newton Rigg	16.6	0.85
						Leeming	7.7	1.84
						Scarborough	8.1	1.75
4.	Westmorland	39.2	Newton Rigg	16.6	2.36	Sellafield	25.8	1.52
						Cartmel	29.1	1.35
5.	Yorkshire, North Riding	14.5	Leeming	7.7	1.89	Durham	8.6	1.69
			Scarborough	8.1	1.79	High Mowthorpe	12.1	1.20
						Harrogate	12.6	1.15
						Newton Rigg	16.6	0.87
6.	Lancashire	22.9	Cartmel	29.1	0.79	Sellafield	25.8	0.89
			Kirkham	17.4	1.32	Harrogate	12.6	1.82
			Ringway	14.3	1.60	Hawarden Bridge	9.3	2.46
7.	Yorkshire, West Riding	17.5	Harrogate	12.6	1.39	Leeming	7.7	2.27
			Cawood	7.3	2.40	Newton Rigg	16.6	1.05
						Warsop	5.6	3.13
						Morley	9.0	1.94
8.	Yorkshire, East Riding	9.4	Hull	7.7	1.22	Leeming	7.7	1.22
			High Mowthorpe	12.1	0.78	Scarborough	8.1	1.16
						Finningley	5.3	1.77
						Askham Bryan	8.8	1.07

County	County Average EWR ins	Reference Stations In County	Station Average EWR ins	Conversion Factor	Reference Stations Outside County	Station Average EWR ins	Conversion Factor
9. Cheshire	13.1	Hawarden Bridge	9.3	1.41	Hanmer	11.1	1.18
		Ringway	14.3	0.92	Newport	8.1	1.62
					Stone	9.8	1.34
					Morley	9.0	1.46
10. Derby	15.4	Morley	9.0	1.71	Penkridge	10.6	1.45
					Warsop	5.6	2.75
					Stone	9.8	1.57
					Harrogate	12.6	1.22
11. Nottingham	8.0	Warsop	5.6	1.43	Finningley	5.3	1.51
		Sutton Bonington	7.0	1.14	Lincoln	6.3	1.27
					Newton Linford	9.0	0.89
					Morley	9.0	0.89
12. Lincoln	7.1	Finningley	5.3	1.34	Hull	7.7	0.92
		Manby	5.4	1.31	Wittering	5.6	1.27
		Lincoln	6.1	1.16			
12a. Lincoln (Holland)	6.9	Terrington St Clement	3.8	1.82	Wittering	5.6	1.23
					Lincoln	6.1	1.13
					Marham	5.9	1.17
13. Rutland	8.9	Wittering	5.6	1.59	Newton Linford	9.0	0.99
					Sutton Bonington	7.0	1.27
					Raunds	5.4	1.65
14. Leicester	10.1	Newton Linford	9.0	1.12	Sutton Bonington	7.0	1.44
					Elmdon	12.3	0.82
					Raunds	5.4	1.87
15. Stafford	13.9	Stone	9.8	1.42	Newport	8.1	1.72
		Penkridge	10.6	1.31	Elmdon	12.3	1.13
					Morley	9.0	1.54
					Ringway	14.3	0.97

	County	County Average EWR ins	Reference Stations In County	Station Average EWR ins	Conversion Factor	Reference Stations Outside County	Station Average EWR ins	Conversion Factor
16.	Shropshire	11.8	Newport	8.1	1.46	Welshpool	15.3	0.77
						Hawarden Bridge	9.3	1.27
						Stone	9.8	1.20
						Preston Wynne	7.7	1.53
17.	Hereford	13.1	Preston Wynne	7.7	1.70	Pershore	7.7	1.70
						Gloucester	10.4	1.26
						Usk	19.6	0.67
						Brecon	23.7	0.55
						Radnor	22.3	0.59
18.	Worcester	10.3	Pershore	7.7	1.34	Preston Wynne	7.7	1.34
						Newport	8.1	1.27
						Elmdon	12.3	0.84
						Gloucester	10.4	0.99
19.	Warwick	10.4	Elmdon	12.3	0.85	Pershore	7.7	1.35
			Wellesbourne	7.3	1.42	Penkridge	10.6	0.98
						Raunds	5.4	1.93
						Oxford	8.0	1.30
20.	Northampton	8.2	Raunds	5.4	1.52	Newton Linford	9.0	0.91
			Wittering	5.6	1.46	Wellesbourne	7.3	1.12
						Oxford	8.0	1.03
						Silsoe	5.1	1.61
21.	Huntingdon	6.1	Boxworth	4.4	1.39	Raunds	5.4	1.13
						Wittering	5.6	1.09
						Cambridge	4.7	1.30
						Silsoe	5.1	1.20
22.	Cambridge	6.0	Terrington	3.8	1.58	Boxworth	4.4	1.36
			Cambridge	4.7	1.28	Silsoe	5.1	1.18
						Honington	4.1	1.46
						Marham	5.9	1.02

	County	County Average EWR ins	Reference Stations In County	Station Average EWR ins	Conversion Factor	Reference Stations Outside County	Station Average EWR ins	Conversion Factor
23.	Norfolk	7.9	Marham	5.9	1.34	Terrington	3.8	2.08
			Morley St Botolph	9.0	0.88	Lowestoft	6.0	1.32
						Honington	4.1	1.93
24.	Suffolk	7.2	Lowestoft	6.0	1.20	Cambridge	4.7	1.53
			Walton-on-Naze	4.5	1.60	Marham	5.9	1.22
			Honington	4.1	1.76	Stansted	6.6	1.09
25.	Essex	6.3	Stansted	6.6	0.95	Walton-on-Naze	4.5	1.40
			Writtle	5.5	1.15	Cambridge	4.7	1.34
						Rothamsted	8.5	0.74
						Gillingham	6.0	1.05
26.	Hertford	7.7	Rothamsted	8.5	0.91	Silsoe	5.1	1.51
						Cambridge	4.7	1.64
						Stansted	6.6	1.17
						Woburn	6.5	1.18
27.	Bedford	6.9	Silsoe	5.1	1.35	Woburn	6.5	1.06
						Raunds	5.4	1.28
						Boxworth	4.4	1.57
						Cambridge	4.7	1.47
28.	Buckingham	8.9	Woburn	6.5	1.37	Oxford	8.0	1.11
			Hurley	6.8	1.31	Raunds	5.4	1.65
						Rothamsted	8.5	1.05
						Shinfield	6.9	1.29
29.	Oxford	9.1	Oxford	8.0	1.14	Wellesbourne	7.3	1.25
			Hurley	6.8	1.34	Woburn	6.5	1.40
						Gloucester	10.4	0.87
30.	Gloucester	12.4	Gloucester	10.4	1.19	Lacock	10.3	1.20
			Long Ashton	16.1	0.77	Oxford	8.0	1.55
						Pershore	7.7	1.61
						Usk	19.6	0.63

County	County Average EWR ins	Reference Stations In County	Station Average EWR ins	Conversion Factor	Reference Stations Outside County	Station Average EWR ins	Conversion Factor
31. Somerset	16.2	Long Ashton	16.1	1.01	Chivenor	15.8	1.03
		Cannington	10.9	1.49	Lacock	10.3	1.57
					Boscombe Down	10.7	1.51
32. Wiltshire	13.2	Lacock	10.3	1.28	Long Ashton	16.1	0.82
		Boscombe Down	10.7	1.23	Gloucester	10.4	1.27
					Leckford	12.3	1.07
33. Berkshire	8.8	Oxford	8.0	1.10	Hurley	6.8	1.29
		Shinfield	6.9	1.27	Leckford	12.3	0.71
					Alice Holt	11.5	0.77
					Lacock	10.3	0.85
34. London	7.3	Southgate	7.5	0.97	Rothamsted	8.5	0.86
					Gillingham	6.0	1.22
					Wisley	7.4	0.99
					Croydon	7.3	1.00
35. Surrey	10.4	Wisley	7.4	1.41	Southgate	7.5	1.39
		Croydon	7.3	1.42	Gillingham	6.0	1.73
					Alice Holt	11.5	0.90
					Fernhurst	13.3	0.78
36. Kent	8.7	Gillingham	6.0	1.45	Bodiam	12.7	0.69
		East Malling	8.2	1.06	Croydon	7.3	1.19
		Herne Bay	4.6	1.89			
		Wye	10.3	0.84			
37. Sussex	12.7	Fernhurst	13.3	0.95	East Malling	8.2	1.55
		Bodiam	12.7	1.00	Thorney Island	8.0	1.59
					Alice Holt	11.5	1.10
38. Hampshire	12.5	Alice Holt	11.5	1.09	Fernhurst	13.3	0.94
		Thorney Island	8.0	1.56	Boscombe Down	10.7	1.17
		Leckford	12.3	1.02			
		Efford	14.0	0.89			

	County	County Average EWR ins	Reference Stations In County	Station Average EWR ins	Conversion Factor	Reference Stations Outside County	Station Average EWR ins	Conversion Factor
39.	Isle of Wight	12.4	Shanklin	15.6	0.79	Efford	14.0	0.89
						Thorney Island	8.0	1.55
40.	Dorset	16.4	Weymouth	11.0	1.49	Boscombe Down	10.7	1.53
						Efford	14.0	1.17
						Cannington	10.9	1.50
41.	Devon	24.2	Chivenor	15.8	1.53	Cannington	10.9	2.22
			Newton Abbot	18.8	1.29	Weymouth	11.0	2.20
			Plymouth	17.9	1.35	Cambourne	17.6	1.37
42.	Cornwall	24.4	Cambourne	17.6	1.39	Plymouth	17.9	1.36
			Ellbridge	20.1	1.21	Chivenor	15.8	1.54
			Penzance	20.4	1.20			
				WALES				
1.	Anglesey	18.9	Llwydiarth	17.5	1.08	Conway	11.3	1.67
2.	Caernarvon	22.9	Conway	11.3	2.03	Llwydiarth	17.5	1.31
						Denbigh	13.3	1.72
						Arthog	37.3	0.61
3.	Denbigh	22.4	Denbigh	13.3	1.68	Conway	11.3	1.98
			Wrexham	15.4	1.45	Hanmer	11.1	2.02
						Derwen	20.7	1.08
4.	Flint	14.1	Hanmer	11.1	1.27	Wrexham	15.4	0.91
						Hawarden Bridge	9.3	1.52
						Ringway	14.3	0.99
						Denbigh	13.3	1.06
5.	Merioneth	49.0	Arthog	37.3	1.31	Aberporth	20.8	2.35
			Derwen	20.7	2.37	Welshpool	15.3	3.20
						Denbigh	13.3	3.68
						Wrexham	15.4	3.18

	County	County Average EWR ins	Reference Stations In County	Station Average EWR ins	Conversion Factor	Reference Stations Outside County	Station Average EWR ins	Conversion Factor
6.	Montgomery	34.3	Welshpool	15.3	2.24	Derwen	20.7	1.66
						Radnor	22.3	1.54
						Newport	8.1	4.23
7.	Cardigan	31.7	Aberporth	20.8	1.52	Arthog	37.3	0.85
						Radnor	22.3	1.42
						Brecon	23.7	1.34
						Carmarthen	30.8	1.03
8.	Radnor	27.0	Radnor	22.3	1.21	Welshpool	15.3	1.76
						Brecon	23.7	1.14
						Preston Wynne	7.7	3.51
9.	Pembroke	26.9	Pembroke	20.6	1.31	Aberporth	20.8	1.29
						Carmarthen	30.8	0.87
10.	Carmarthen	35.0	Carmarthen	30.8	1.14	Pembroke	20.6	1.70
						Aberporth	20.8	1.68
						Brecon	23.7	1.48
						Cardiff	21.9	1.60
11.	Brecon	38.1	Brecon	23.7	1.61	Radnor	22.3	1.71
						Usk	19.6	1.94
						Cardiff	21.9	1.74
						Carmarthen	30.8	1.24
						Preston Wynne	7.7	4.95
12.	Glamorgan	37.2	Cardiff	21.9	1.70	Carmarthen	30.8	1.21
						Brecon	23.7	1.57
						Usk	19.6	1.90
13.	Monmouth	24.0	Usk	19.6	1.22	Cardiff	21.9	1.10
						Brecon	23.7	1.01
						Preston Wynne	7.7	3.12
						Gloucester	10.4	2.31

Agricultural Memorandum No 549

The entry for "Gloucester" should be amended to read:-

County	Reference Station	Station Average EWR	Conversion factor
17. Hereford	Cirencester	14.3	0.92
18. Worcester	Cirencester	14.3	0.72
29. Oxford	Cirencester	14.3	0.64
30. Gloucester	Cirencester	14.3	0.87
Wales			
13. Monmouth	Cirencester	14.3	1.68

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